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Intermittency Studies in $\overline{p}p$ Collisions at $\sqrt{s}$ = 1800 GeV

The CDF Collaboration
presented by F. Rimondi
Fermi National Accelerator Laboratory
P.O. Box 500, Batavia, Illinois 60510

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INTERMITTENCY STUDIES IN $\bar{p}p$ COLLISIONS AT $\sqrt{s} = 1800$ GeV.

CDF Collaboration*

presented by FRANCO RIMONDI
University of Bologna and INFN Bologna, Italy

ABSTRACT

Preliminary data on intermittency in $\bar{p}p$ minimum bias interactions at $\sqrt{s} = 1800$ GeV are presented. The factorial moments computed as a function of decreasing pseudorapidity bin size increase in the $\delta\eta$ region between 1 and about 0.1. A flattening, more pronounced for higher order factorial moments, shows up for $\delta\eta$ below ≈ 0.13.

The aim of this note is to describe a preliminary study of the non statistical particle density fluctuations in individual events in small pseudorapidity intervals in $\bar{p}p$ interactions at $\sqrt{s} = 1800$ GeV.

The factorial moments (*FM*) formalism proposed by Bialas and Peschanski is applied[1] . The method suggests to studing the *FM* of kinematic distributions as a function of phase space resolution. In particular, the *FM* of the pseudorapidity distribution can be studied as a function of the pseudorapidity bin size. The presence of non-statistical fluctuations from event to event reveals itself as an increase of the *FM* with decreasing bin size.

This behavior, usually referred to as intermittency, has been observed in hh, hl, ll and nucleus-nucleus interactions[2-5] . While recent results[6,7] show that, at the LEP energy, intermittency in e^+e^- interactions is well reproduced by JETSET parton shower and matrix element QCD based hadronization models, none of the current models appear able to predict the behavior of the *FM* in hadron-hadron interactions.

There has been much speculation[1,8-9] upon the possible sources of the observed fluctuations, particularly in nucleus-nucleus and pp collisions.

The preliminary data presented here are the first results in $\bar{p}p$ interactions at $\sqrt{s} = 1800$ GeV. The experiment has been performed by the CDF collaboration at the Fermilab Tevatron-Collider.

* Argonne National Laboratory,Brandeis University,University of Chicago, Fermi National Accelerator Laboratory,Laboratori Nazionali di Frascati, Harvard University, University of Illinois, The John Hopkins University, National Laboratory for High Energy Physics(KEK),Lawrence Berkeley Laboratory, University and INFN sezione di Padova, University of Pennsylvania,University and INFN sezione di Pisa,Purdue University, University of Rochester, Rockfeller University, Rutgers University, Texas A&M University, University of Tsukuba,Tufts University,University of Wisconsin.

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A detailed description of the experimental apparatus, as well as of the minimum bias trigger and the event selection, have been reported elsewhere [10,11]. Here only a few things relevant to the present analysis will be described. The central region of the CDF apparatus is provided with two tracking systems. The VTPC, a set of eight time-projection chambers surrounding the beam pipe at the interaction point. The chambers cover a region of about $\pm$ 3 units in η and 2π in azimuth. They provide good η measurement but φ is not well determined for about the 20% of the tracks and only for about the 15% of the tracks is it possible to measure the momenta. Just outside the VTPC the central tracking chamber (CTC), a large volume axial drift chamber with small angle stereo wire layers, measures all the kinematic parameters of the tracks, with excellent momentum resolution. It covers a range of pseudorapidity of about ± 1.5 units around 0. The mean η resolution of the CTC is below ≈ 0.006 and its two-track resolution is estimated to be about the same value.

The currently used definition of the "vertical" averaged normalized *FM* ($< F_q >$) (see for example ref.7, formula 2) has been adopted. The data presented here are based on about 339,000 fully reconstructed minimum bias events, recorded in the 1988/89 run. Tracks measured by the CTC have been used.

The selected $\Delta\eta$ interval is $\mid \eta \mid < 1$. In this region the CTC average reconstruction efficiency is 99% for tracks with $p_t > 0.4$ GeV/c.

Only selected tracks with vertex constrained fit and p_t greater than the above values have been used.

The event is accepted if the primary vertex has $\mid Z_{vert} \mid < 60$ cm.

In order to minimize the background from multivertex interactions, events with more than one primary vertex in 60 cm have been rejected.

In Fig.1a the logarithm of the "raw" $< F_q >$ are shown as a function of -log(δ), where δ is the bin size. The $< F_q >$ were computed for pseudorapidity intervals ranging from $\delta\eta = 2$ to $\delta\eta = 0.08$.

No corrections have been applied, at this level, to the data for the acceptance of the CTC and for effects due to particle decays, secondary interactions, or photon conversion.

In order to evaluate the resulting systematic errors on the $< F_q >$ as well as the effects of the large p_t cut, Monte Carlo simulations have been used, according to the procedure described in ref.7. There the corrected $< F_q >$ are obtained multiplying the raw values by the ratio of the Monte Carlo $< F_q >$ computed at the generation level over the Monte Carlo $< F_q >$ after simulation through the detector.

Events were generated by using the MB1 generators. MB1 is a minimum bias generator which naively extrapolates the CERN-ISR and SPS data to the Tevatron-Collider energy region. It reproduces multiplicity, tranverse momentum, and rapidity distributions. Some correlations are considered but some are not. Two situations have been investigated.

In the first case the generated, stable Monte Carlo tracks in the CTC pseudo-rapidity acceptance have been used to compute the $< F_q >$ at the generation level with no p_t cut applied.

This correction, which accounts for the CTC $p_t > 0.4$ GeV/c cut, affects both the absolute value and the slope of the $< F_q >$.

The corrected $< F_q >$ are shown in Fig.1b.

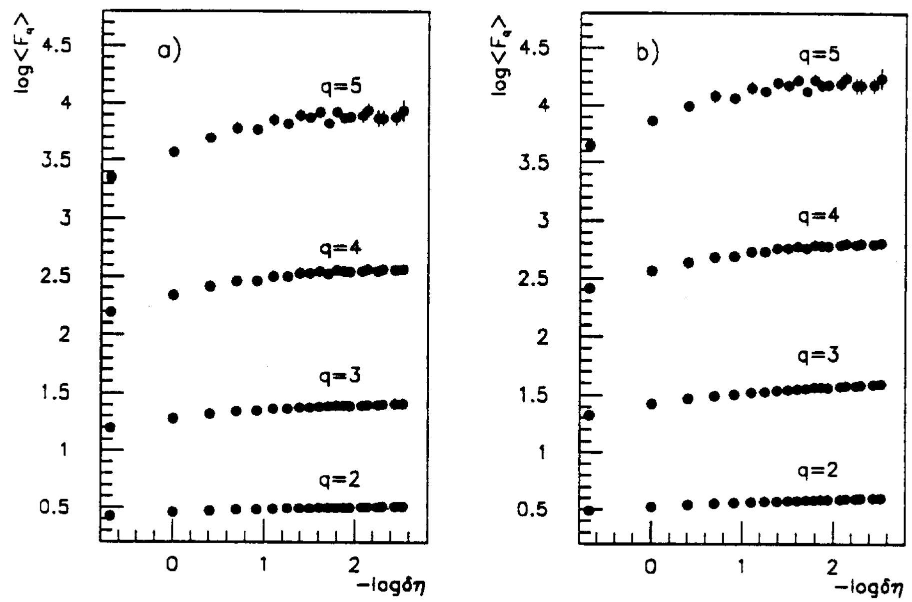

Figure .1: **a)** *Ln* **of the "raw"** $< F_q >$ **as a function of -log(**$\delta\eta$**); b)** *Ln* **of the corrected** $< F_q >$ **as a function of -log(**$\delta\eta$**).**

In the second case only Monte Carlo generated charged particles with p_t greater than 0.4 GeV/c were used to compute the generated $< F_q >$. This correction also changes the absolute value of the $< F_q >$, but only moderately affects the slope (results not showed in the figures).

Due to the preliminary stage of the analysis and the limited Monte Carlo statistics the uncertainties on the correction factors are large especially for higher order *FM*. For this reason as well as for the necessity of detailed studies of the numerous systematic effects the slopes of the *FM* dependence on the pseudorapidity bin size are not quoted. Qualitatively the present data show an almost linear increase, in a log-log plot, of the *FM* with decreasing bin size in the $\delta\eta$ region between about

1 and 0.1. A flattening, more pronounced for the moments of order four and five, shows up at $\delta\eta$ around 0.13. Assuming a linear rise of $< F_q >$ in the above mentioned $\delta\eta$ region, these data indicate the presence of the intermittency effect in $\bar{p}p$ interactions at $\sqrt{s} = 1800$ GeV.

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